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Novel Modified Seldinger Technique for Gastrojejunal Feeding Tube Placement

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ABSTRACT

Background: Temporary or long-term nutritional support through gastrojejunal (GJ) feeding tubes is a safe and common means of enteral feeding in adults and children. It is indicated in patients with severe gastroesophageal reflux disease, gastric outlet obstruction, or severe gastric dysfunction or gastroparesis. Several techniques for GJ feeding tube placement have been reported. The most technically challenging part of GJ tube placement is the advancement and optimal positioning of the jejunal extension into the proximal jejunum.

Methods: A novel modified Seldinger technique was used for endoscopic placement of a percutaneous low-profile GJ tube (14 French). After gastric access was established, a dilator was advanced under endoscopic vision into the pylorus. Under fluoroscopy, a guidewire was threaded through the dilator into the duodenum. The dilator was then removed, and the GJ tube advanced over the guidewire.

Results: A total of 12 patients including 9 pediatric and 3 adult underwent the procedure with no complications. The main indication was gastroparesis with oral intolerance of food. The median operative time was 41.5 minutes. All patients tolerated jejunal tube feeding after surgery.

Conclusion: The modified Seldinger technique for percutaneous endoscopic GJ tube placement is a safe and efficient procedure in both children and adults. Further studies are necessary to prove its reproducibility in other centers and to compare it to other methods of PEGJ tube placement.

Key Words: Enteral feeding, Gastrojejunostomy, Percutaneous endoscopic gastrojejunal tube, Percutaneous endoscopic gastrostomy tube, Malnutrition.

INTRODUCTION

In patients with inadequate oral intake requiring nutrition supplementation, enteral feeding is preferred over parenteral nutrition. Since the introduction of percutaneous endoscopic gastrostomy (PEG) in 1980, this technique has been established as a safe procedure for gastric feeding access in children with inadequate oral intake.[1,2] Its use was initially described in malnourished, neurologically impaired children who failed a swallow study.[3] PEG placement has been shown to have a shorter operative time, lower complication rate, and shorter recovery time when compared to open surgical Stamm gastrostomy.[4]

Percutaneous endoscopic gastrojejunal (PEGJ) feeding tube placement was introduced into practice in 1984.[5] It was designed to be used in cases where postpyloric tube feeding was indicated, such as severe gastroesophageal reflux disease (GERD), gastric outlet obstruction, gastroparesis, and other conditions resulting in delayed gastric emptying.[6,7] It can be used as an alternative to gastric feeding when complicated by GERD, or tracheal aspiration, or both, particularly in children who are deemed unsuitable candidates for antireflux surgery or in patients in whom fundoplication has failed.[8] GJ feeding is very well tolerated but requires continuous enteral nutrition which is sometimes considered a burden for patients and caregivers.[3]

A GJ feeding tube is an ideal option for patients in need of short-term postpyloric feeding. Its long-term use is limited by the risk of migration of the jejunal extension of the GJ tube back into the stomach.[3]

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MATERIALS AND METHODS

The procedures were performed in 2 hospitals by 2 surgeons. With institutional review board approval, we used a low-profile, skin-level GJ tube with separate gastric and jejunal ports (G-JET, 14 French; American Medical Technology [AMT], Brecksville, Ohio, USA). Both, endoscopy and fluoroscopy were used to assure adequate placement of the jejunal extension of the GJ tube. This technique was performed in 9 pediatric and 3 adult patients (n = 12) with 100% success rate and no intraoperative or postoperative complications.

Surgical Technique

The procedure was performed in the operating room by fluoroscopy and endoscopy. Sterile laparoscopic and laparotomy instruments were available in case percutaneous placement was not possible. The patient was placed supine, and the abdomen was sterilely prepped and draped. After endotracheal intubation and induction of anesthesia, an appropriately sized endoscope was advanced transorally into the stomach and the stomach insufflated with CO_2 (**Figure 1A**). Endoscopic transillumination and finger indentation of the gastric anterior wall were used to verify appropriate placement (**Figure 1B, C**).

Under endoscopic guidance, an 18-gauge spinal needle with a looped strand of 0 polydioxanone suture (PDS) was advanced through the abdominal wall into the stomach. A second spinal needle was introduced into the stomach 1.0 to 1.5 cm inferiorly, and a single 0 PDS strand was advanced so that it passed through the previously introduced loop. Retrieval of the first loop enabled snaring and pulling of the single strand back through the abdominal wall, creating a U-stitch. A second U-stitch was then placed medially by using the same technique. Gentle traction was applied to both U-stitches to ensure snug apposition of the gastric wall to the peritoneum of the anterior abdominal wall (**Figure 1D–G**). In the center of the U-stitches, after placement of local anesthetic, a small vertical incision was made using the needle tip electrocautery (**Figure 1H**).

To obtain gastric access we used a placement kit containing a metal guidewire, an 18-gauge needle, and plastic dilators of sequential size (AMT) (**Figure 2A**). The 18-gauge needle was used to access the stomach and, under endoscopic visualization, a metal guidewire was advanced into the stomach. The Seldinger technique was used to sequentially expand the tract to 16 French with the dilators. After removal of the metal guidewire, the pylorus

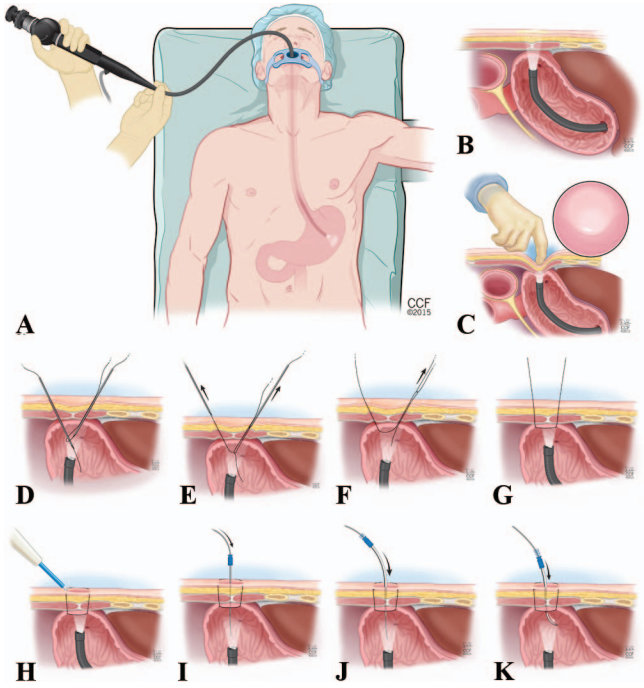

Figure 1. Percutaneous endoscopic gastrostomy performed with the Seldinger technique. (**A**) Advancement of the endoscope transorally into the stomach with insufflation. (**B**, **C**) Transillumination and finger indentation of the anterior abdominal wall. (**D–G**) Transgastric suture fixation of the stomach to the abdominal wall. (**H**) Longitudinal incision between the fixation sutures. (**I–K**) The Seldinger technique used to create a gastrostomy, with the pylorus intubated with a 16-French dilator through which a glidewire is passed.

was directly intubated with the tip of a dilator (**Figure 1I–K**). This step is the key to efficiently directing a guidewire, and ultimately the GJ tube, into position. For jejunal access, we used a 0.1 cm (0.038 in) × 150 cm (59 in) J-tip hydrophilic Sensor glidewire (Boston Scientific, Marlborough, MA, USA) (**Figure 2B**). The glidewire was inserted through the dilator and advanced into the jejunum under fluoroscopic vision.

Midline crossing of the guidewire was verified by fluoroscopy. The glidewire was stabilized in place manually, and the dilator was then slowly retracted.

The GJ tube had proximal gastrostomy access for administration of medication or gastric decompression and distal jejunostomy access with an attachable external extension for tube feeding (**Figure 2C, D**).

Under fluoroscopic guidance, the lubricated GJ tube was advanced over the glidewire into the jejunum by using the Seldinger technique (**Figure 3A, B**). The glidewire was

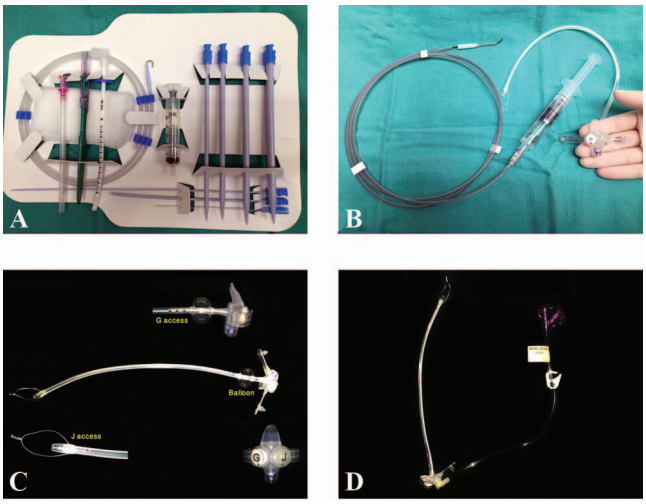

Figure 2. (**A**) Gastrostomy placement kit: scalpel, metal guidewire, 18-gauge needle, and sequential dilators. (**B**) A 0.1 cm (0.038 in) × 150 cm (59.055 in) J-tip hydrophilic Sensor glidewire (Boston Scientific, Marlborough, MA USA). (**C**) Low-profile GJ tube with separate gastric and jejunal ports. (**D**) The jejunal port is attached to an external extension for tube feeding.

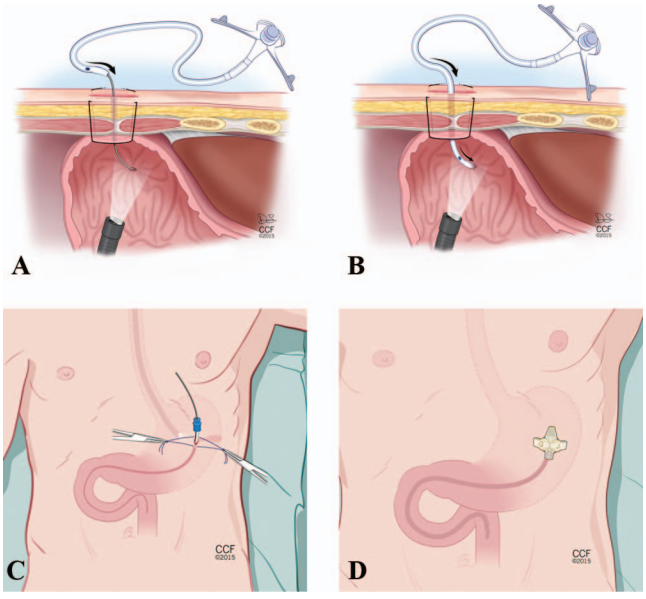

Figure 3. (**A**, **B**) The GJ tube is advanced over the glidewire into the jejunum under fluoroscopy. (**C**, **D**) The U-stitches are tied around the GJ tube and the balloon is inflated.

then removed, and the U-stitches loosely tied around the external portion of the GJ tube (**Figure 3C, D**). Under endoscopic visualization, the balloon was then inflated with sterile water. A final abdominal radiograph confirmed proper placement (**Figure 4**).

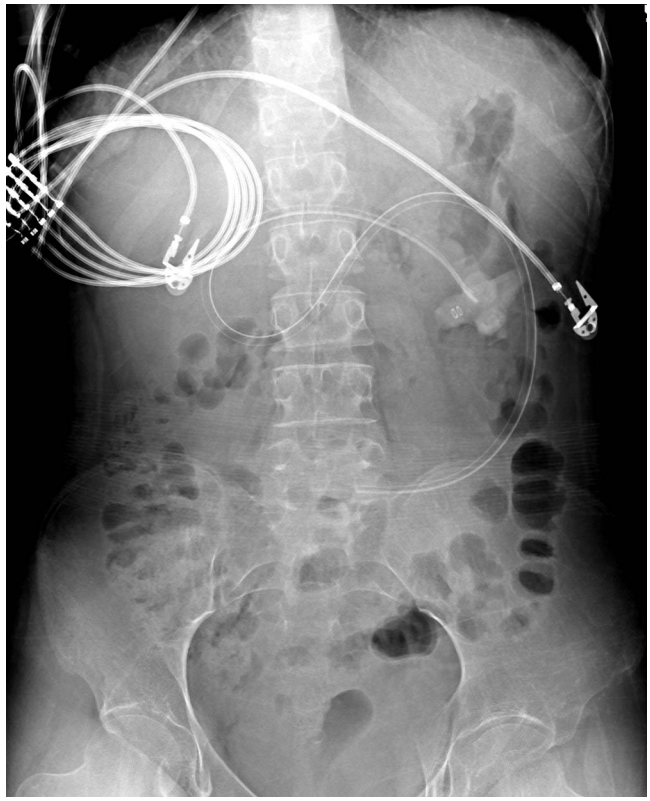

Figure 4. An abdominal radiograph confirms the proper placement of the GJ tube.

RESULTS

All 12 patients underwent GJ tube placement with no postoperative complications (**Table 1**). The main indication was gastroparesis with oral intolerance (n = 6), followed by GERD with aspiration (n = 3), global intestinal dysmotility (n = 2), and metastatic gastric adenocarcinoma with gastric outlet obstruction (n = 1). The median operative time was 41.5 [interquartile range (IQR), 25] minutes. All patients tolerated jejunal tube feeding after surgery. We note that our operative time decreased significantly over time. The mean operative time in our first 5 cases was 64 minutes, whereas in the last 5, it was reduced to 30 minutes ($P < .001$).

DISCUSSION

PEGJ tube placement may be performed as a single-stage procedure, starting with the creation of a gastrostomy followed by the placement of a GJ tube. An alternative method is to use an existing gastrostomy track. In both methods, the jejunal extension is manipulated into position by fluoroscopy, endoscopy, or both.[3] Several tech-

Table 1.
Demographics, Presentation, Operative Time, and Outcome of Patients

Case	Age	Gender	Indication	Op time (min)	Postop TF tolerance
1	3 mo	M	Recurrent aspiration and failure to thrive	29	+
2	4 mo	M	Chronic constipation and intractable gastroparesis	38	+
3	5 mo	F	Global dysmotility, failure to thrive	43	+
4	6 mo	M	Congenital diaphragmatic hernia, GERD, aspiration pneumonia, existing PEG tube	21	+
5	13 yr	M	Ring chromosome 14 syndrome, epilepsy, gastroparesis	75	+
6	15 yr	M	Severe cerebral palsy, GERD, recurrent aspiration pneumonia	84	+
7	16 yr	F	Avoidant/restrictive food intake disorder, DM induced gastroparesis	38	+
8	17 yr	F	Chronic constipation, gastroparesis	40	+
9	17 yr	F	Gastroparesis	22	+
10	18 yr	M	Metastatic gastric adenocarcinoma with pyloric involvement	55	+
11	19 yr	F	Global intestinal dysmotility, SMA syndrome	54	+
12	29 yr	F	DM-induced severe gastroparesis	63	+

DM, diabetes mellitus; SMA, superior mesenteric artery; TF, tube feeding.

niques have been developed to facilitate this crucial step of the procedure. Another technique for GJ tube placement is the introduction of a pediatric endoscope directly through a gastrostomy site, which is then advanced through the pylorus, the duodenum, and the jejunum. A guidewire is inserted through the instrument channel of the endoscope, and the endoscope is removed. The GJ tube is then advanced over the wire.[6] Alternatively, the GJ tube can be advanced into the stomach via the gastrostomy, and the jejunal extension grasped with a transoral endoscope and guided through the pylorus into the small bowel.

The modified Seldinger technique presented herein was successful in placing a GJ tube in 12 patients with no intraoperative or postoperative complications. To prevent early tube dislodgement and intraperitoneal gastric leak, we used transgastric U-suture fixation of the stomach to the abdominal wall. This technique is less demanding than the conventional endoscopic transgastric technique where a pediatric endoscope is advanced through the gastrostomy site into the pylorus.

The flexible scope can render the intubation of the pylorus challenging and can be time consuming. In addition, small-bowel endoscopy carries the risk of perforation.[9] Intubation of the pylorus with the dilator under endoscopic guidance is straightforward, and hollow viscus injury from the flexible glidewire is very unlikely.

After applying this technique in the first 3 patients, we noted that the glidewire did not have to be advanced into the jejunum for successful GJ tube placement. The stiff jejunal extension frequently found its way into the jejunum by constant pressure over the glidewire.

A permanent jejunostomy, created by open or laparoscopic approach, is an alternative to PEGJ. In comparison to a permanent jejunostomy, our endoscopic technique is less invasive, with the benefit of reduced postoperative pain. However, the endoscopic technique carries the inherent limitation of nonvisualization of the peritoneal cavity, with the risk of inadvertent bowel injury.

Proper transillumination and finger indentation limits these complications and we strongly advocate for early conversion to the laparoscopic technique in cases in which safe gastric access cannot be achieved. The open Witzel jejunostomy does not allow the use of self-retaining catheters in children with the risk of tube dislodgement and peritoneal spillage with recannulation attempts, and subsequent operative interventions.[10] The Roux-en-Y feeding jejunostomy (Maydl's procedure) was introduced in 1888[11] and found to be a safe and feasible procedure in critically ill patients who require permanent feeding access. This procedure has revised from formation of a stoma to placement of an indwelling tube into the Roux limb,[12] and it had the advantage of reducing duodenogastric bile reflux.[10] Laparoscopic jejunal feeding tube place-

ment has the benefit of reduced postoperative pain and quicker return of bowel function compared to open methods.[1,2] Percutaneous endoscopic jejunostomy (PEJ) feeding tubes have also been used when postpyloric enteral feeding is indicated. However, this technique is limited by technical difficulties and challenges in stabilizing the jejunal loop against the abdominal wall.[3]

The described modified Seldinger technique for PEGJ feeding tube placement was reproducible, and we performed this procedure with the adult patients under light sedation and local anesthesia. In the pediatric patients, we used general anesthesia. Radiation exposure is limited and considered negligible. Generalization of these results is limited by its retrospective nature and the small number of patients.

CONCLUSION

The modified Seldinger technique for PEGJ placement was shown to be safe and efficient in both adults and children. It represents an alternative method for PEGJ tube placement that uses the endoscopic skill of the surgeon. Further studies are needed to prove its reproducibility in other centers and to compare it to other methods of PEGJ tube placement.

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